PESTICIDE SURFACE WATER QUALITY REPORT

JANUARY 1999 SAMPLING EVENT

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Pesticide Monitoring Project Report
January 1999 Sampling Event

Executive Summary

As part of the District's quarterly ambient monitoring program, unfiltered water samples from 36 sites were collected from January 6 to January 12, 1999 and analyzed for over sixty pesticides and/or products of their degradation. The herbicides ametryn, atrazine, bromacil, hexazinone, metolachlor, metribuzin, norflurazon, and simazine, along with the insecticides diazinon, alpha- and beta-endosulfan, endosulfan sulfate, ethoprop, and malathion, were detected in one or more of these surface water samples. The diazinon concentration of 0.067 µg/L at S38B is more than an order of magnitude less than the 48 hour EC_{50} of 0.8 µg/L reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. However, it is slightly greater than the chronic toxicity level (0.04 µg/L) for *Daphnia magna*, calculated according to the promulgated procedure (FAC 62-302.200). At this level, long-term exposure can cause adverse impacts to the macroinvertebrate populations, but the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about long term average exposures. The compounds and concentrations found are typical of those expected from intensive agricultural activity.

Background and Methods

The District's pesticide monitoring network includes stations designated in the Everglades National Park Memorandum of Agreement, the Miccosukee Tribe Memorandum of Agreement, the Lake Okeechobee Operating Permit, and the non-Everglades Construction Project (non-ECP) permit. Surface waters are sampled quarterly and sediments semiannually.

Sixty-two pesticides and degradation products were analyzed for in samples from all of the 36 sites (Figure 1). The analytes, their respective minimum detection limits (MDL), and practical quantitation limits (PQL) are listed in Table 1. Each pesticide's description and possible uses and sites of application are taken from Hartley and Kidd (1987). The Florida Ground Water Guidance Concentrations (FDEP, 1994) are listed to provide an indication at what level these pesticide residues could possibly impact human health, based on drinking water consumption or other routes of exposure (e.g., inhalation, ingestion of food residues, dermal uptake). Primary ground water standards are enforceable ground water standards, not screening tools or guidance levels. To evaluate the potential impacts on aquatic life, due to the pulsed nature of exposure, the maximum observed concentration is compared to the Criterion Maximum Concentration published by the USEPA under Section 304 (a) of the Clean Water Act, if available, or the lowest EC_{50} or LC_{50} reported in the summarized literature. This summary covers surface water samples collected between January 6 and January 12, 1999.

Findings and Recommendations

At least one pesticide was detected in the surface water at 35 of the 36 sites. The concentrations of the pesticides detected at each of the sites are summarized for the surface water in Table 2. The diazinon concentration of 0.067 µg/L at S38B is more than an order of magnitude less than the 48 hour EC_{50} of 0.8 µg/L reported for *Daphnia magna*, a sensitive indicator species for

aquatic macroinvertebrates. However, it is slightly greater than the chronic toxicity level (0.04 µg/L) for *Daphnia magna*, calculated according to the promulgated procedure (FAC 62-302.200). At this level, long-term exposure can cause adverse impacts to the macroinvertebrate populations, but the pulsed nature of agricultural runoff releases to the canal system precludes drawing any conclusions about long term average exposures. Ethion was not detected at S99 during this sampling event (Figure 2). However, since March 1995, seven out of seventeen sampling events had a detectable level of ethion. With the method detection limit around 0.02 µg/L, any detection will automatically exceed the calculated chronic toxicity (0.003 µg/L). All these compounds have previously been detected in this monitoring program.

The above findings must be considered with the caveat that pesticide concentrations in surface water may vary significantly with relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible long term or chronic toxicity impacts are also reported based on the single sampling event and do not take into account previous monitoring data.

Usage and Water Quality Impacts

Ametryn: Ametryn is a selective terrestrial herbicide registered for use on sugarcane, bananas, pineapple, citrus, corn, and non-crop areas. Most algal effects occur at concentrations > 10 µg/L (Verschueren, 1983). Environmental fate and toxicity data in Tables 3 and 4 indicate that ametryn (1) is lost from soil relatively easily by leaching, surface adsorption, and in surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 14.1 mg/L for goldfish (Hartley and Kidd, 1987). The ametryn surface water concentrations found in this sampling event ranged from 0.0099 to 0.086 µg/L. Using these criteria, these surface water levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Atrazine: Atrazine is a selective systemic herbicide registered for use on pineapple, sugarcane, corn, rangelands, ornamental turf and lawn grasses, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that atrazine (1) is easily lost from soil by leaching and in surface solution, with moderate loss from surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 76 mg/L for carp, 16 mg/L for perch and 4.3 mg/L for guppies (Hartley and Kidd, 1987). Also, in a flow-through bioassay, the maximum acceptable toxicant concentration (MATC) of atrazine was 90 and 210 µg/L for bluegill and fathead minnow (Verschueren, 1983). Atrazine inhibits cell multiplication of the alga, *Microcystis aeruginosa*, at 3 µg/L and most other biological effects occur at higher concentrations (Verschueren, 1983). The atrazine surface water concentrations found in this sampling event ranged from 0.011 to 1.3 µg/L. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Bromacil: Bromacil is a terrestrial herbicide registered for use on pineapple, citrus, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that bromacil (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly.

Additional fish toxicity data includes a 96 hour LC_{50} of 164 mg/L for carp (Hartley and Kidd, 1987). The highest concentration of bromacil detected in the surface water during this sampling event was 0.25 μg/L. Using these criteria, these levels should not have an acute or chronic detrimental impact on fish.

Diazinon: Diazinon is a non-systemic insecticide and acaricide registered for use on wide range of crops including citrus, bananas, vegetables, potatoes, sugar cane, rice and ornamentals. Environmental fate and toxicity data in Tables 3 and 4 indicate that diazinon (1) is easily lost from soil by surface solution, with a moderate loss from leaching, and minimum loss from surface adsorption; (2) is slightly toxic to mammals and relatively toxic to fish; and (3) does not bioaccumulate significantly. The diazinon concentration detected (0.067 μg/L at S38B), should not have an acute, detrimental impact for fish. However, for aquatic invertebrates, this level is slightly greater than the calculated chronic toxicity (0.04 μg/L) for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrates. At this concentration, long term exposure can cause impacts to the macroinvertebrate populations.

Endosulfan: Endosulfan is a non-systemic insecticide and acaricide registered for use on many crops, including beans, tomatoes, corn, cabbage, citrus, and ornamental plants. Technical endosulfan is a mixture of the two stereoisomeric forms, the α (alpha) and the β (beta) forms. Endosulfan is highly toxic to mammals, with an acute oral LD_{50} for rats of 70 mg/kg (Hartley and Kidd, 1987). The Soil Conservation Service rates endosulfan with an extra small potential for loss due to leaching, a large potential for loss due to surface adsorption and a moderate potential for loss in surface solution (Table 4). β-endosulfan's water solubility and Henry's constant indicate volatilization may be significant in shallow waters. A bioconcentration factor of 1,267 indicates a low to moderate degree of accumulation in aquatic organisms (Lyman et al., 1990). The only endosulfan (α plus β) surface water concentration detected (S178) during this sampling event does not exceed the Florida Class III surface water quality standard (Chapter 62-302) of 0.056 μg/L. Since January 1996, 12 sampling events have been performed without an exceedance of the water quality standard (Figure 3).

Endosulfan sulfate: Endosulfan sulfate is an oxidation metabolite of the insecticide endosulfan. The water solubility and Henry's constant indicate that endosulfan sulfate is less volatile than water and concentrations will increase as water evaporates (Table 4)(Lyman et al., 1990). Endosulfan sulfate has a relatively high degree of accumulation in aquatic organisms (Lyman et al., 1990). The surface water concentrations detected in this sampling event range from 0.018 to 0.13 μg/L. No FDEP surface water standard (FAC 62-302) has been promulgated for endosulfan sulfate. However, the highest concentration (0.13 μg/L at S178) exceeds the Florida Class III surface water quality standard of 0.056 μg/L, for the parent compound, endosulfan (Figure 3).

Ethoprop: Ethoprop is a non-systemic soil insecticide/nematicide used on many crops including potatoes, tomatoes, sugarcane and turf. Environmental fate and toxicity data in Tables 3 and 4 indicate that ethoprop (1) has a large potential for loss due to leaching, a medium potential for loss in surface solution, and a small potential for loss due to surface adsorption; (2) is moderately toxic to mammals and relatively non-toxic to fish; and (3) does not bioconcentrate significantly. Aquatic invertebrate LC_{50} toxicity ranges from 13 μg/L to 25.3 μg/L for ethoprop (U.S.

Environmental Protection Agency, 1985). The only surface water concentration of ethoprop found in this sampling event was 0.035 µg/L. This concentration is below a level that would have an acute detrimental impact on fish or aquatic invertebrates.

Hexazinone: Hexazinone is a non-selective contact herbicide that inhibits photosynthesis. Registered uses include sugarcane, pineapple, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that hexazinone (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Hexazinone is practically non-toxic to freshwater invertebrates with an EC_{50} of 145 mg/l for *Daphnia magna* (U.S. Environmental Protection Agency, 1988). The hexazinone surface water concentrations found in this sampling event ranged from only 0.020 to 0.15 µg/L and should not have an acute impact on fish or aquatic invertebrates.

Malathion: Malathion is an insecticide/acaricide used on a variety of crops including fruits, vines, ornamentals, vegetables, and field crops (Hartley and Kidd, 1987). Environmental fate and toxicity data in Tables 3 and 4 indicate that malathion (1) has a small potential for loss from soil by leaching, surface adsorption or surface solution; (2) is relatively non-toxic to mammals but highly toxic to fish; and (3) does not bioaccumulate significantly. The only concentration of malathion found in the surface water from this sampling event was 0.038 µg/L at S99. This concentration is below the Florida Class III Water Quality Standard for surface water (Chapter 62-302) of 0.1 µg/L. Using these criteria, this level should not cause an acute, detrimental impact on fish or aquatic invertebrates.

Metolachlor: Metolachlor is a selective herbicide used on potatoes, sugarcane, and some vegetables. Environmental fate and toxicity data in Tables 3 and 4 indicate that metolachlor (1) has a large potential for loss due to leaching and a medium potential for loss in surface solution and due to surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Metolachlor is non-toxic to birds (Lyman et al., 1990). The highest concentration of metolachlor detected was 0.32 µg/L at S5A. This is more than two orders of magnitude below the calculated chronic action level. Using these criteria, these levels should not have a harmful impact on fish or aquatic invertebrates.

Metribuzin: Metribuzin is a selective systemic herbicide used on a variety of crops including potatoes, tomatoes, sugarcane, and peas. Environmental fate and toxicity data in Tables 3 and 4 indicate that metribuzin (1) has a large potential for loss due to leaching, a medium potential for loss in surface solution, and a small potential for loss due to surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioaccumulate significantly. The only concentration of metribuzin detected was 0.033 µg/L. Using these criteria, this surface water level should not have an acute impact on fish or aquatic invertebrates.

Norflurazon: Norflurazon is a selective herbicide registered for use on many crops including citrus. Environmental fate and toxicity data in Tables 3 and 4 indicate that norflurazon (1) is easily lost from soil surface solution and a moderate potential for loss due to leaching and surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not

bioconcentrate significantly. The LC_{50} for norflurazon is >200 mg/L for catfish and goldfish (Hartley and Kidd, 1987). The norflurazon surface water concentrations ranged from 0.030 to 0.70 µg/L. Even at the highest concentration, this is over two orders of magnitude below the calculated chronic action level. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Simazine: Simazine is a selective systemic herbicide registered for use on many crops including sugarcane, citrus, corn, and non-crop areas. Environmental fate and toxicity data in Tables 3 and 4 indicate that simazine (1) is easily lost from soil by leaching and has a moderate potential for loss due to surface adsorption and surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 49 mg/L for guppies (Hartley and Kidd, 1987). Most of the aquatic biological effects occur at concentrations > 500 µg/L (Verschueren, 1983). Aquatic invertebrate LC_{50} toxicity ranges from 3.2 mg/L to 100 mg/L for simazine (U.S. Environmental Protection Agency, 1984). The highest surface water concentration of simazine found in this sampling event was 0.18 µg/L, far below any level of concern for fish or aquatic invertebrates.

Quality Assurance Evaluation

Four duplicate samples were collected at sites S31, S177, S3, and S191. All the analytes detected in the surface water had precision $\leq$30% RPD. No analytes were detected in the two field blanks submitted, which were collected at S177 and S3. All samples were shipped and all bottles were received.

Low concentrations of representative analytes from each pesticide group/method were added to laboratory water as well as to samples submitted. The matrix spike accuracy for atrazine was out of control limits due to high content of this parameter in the spiked sample for the following sample locations: S190, L3BRS, S8 G94D, ACME1DS, S5A, S6, S7, S2, S3 (including field duplicate and field blank), S4, S235, S78, CR33.5T, S79, FECSR78, S65E, and S191. Comparisons are based on the FDEP Comprehensive Quality Assurance Plan targets for precision and accuracy. Organic quality assurance targets are set according to historically generated data or are adapted from the U.S. Environmental Protection Agency with slight modifications or internal goals, based on FDEP limited data. Parameters with low or high recoveries indicate that the sample matrix interferes with these analyses and interpretation of the respective analytical results should consider this effect.

Glossary

LD_{50}: The dosage which is lethal to 50% of the terrestrial animals tested within a short (acute) exposure period, usually 24 to 96 hours.

LC_{50}: A concentration which is lethal to 50% of the aquatic animals tested within a short (acute) exposure period, usually 24 to 96 hours.

EC_{50}: A concentration necessary for 50% of the aquatic species tested to exhibit a toxic effect short of mortality (e.g., swimming on side or upside down, cessation of swimming) within a short (acute) exposure period, usually 24 to 96 hours.

Koc: The soil/sediment partition or sorption coefficient normalized to the fraction of organic carbon in the soil. This value provides an indication of the chemical's tendency to partition between soil organic carbon and water.

Bioconcentration Factor:
The ratio of the concentration of a contaminant in an aquatic organism to the concentration in water, after a specified period of exposure via water only. The duration of exposure should be sufficient to achieve a near steady-state condition.

Soil or water half-life:
The time required for one-half the concentration of the compound to be lost from the water or soil under the conditions of the test.

MDL: The minimum concentration of an analyte that can be detected with 99% confidence of its presence in the sample matrix.

PQL: The lowest level of quantitation that can be reliably achieved within specified limit of precision and accuracy during routine laboratory operating conditions. The PQL is further verified by analyzing spike concentrations whose relative standard deviation in 20 fortified water samples is < 15%. In general, the PQL is 2 to 5 times larger than the MDL.

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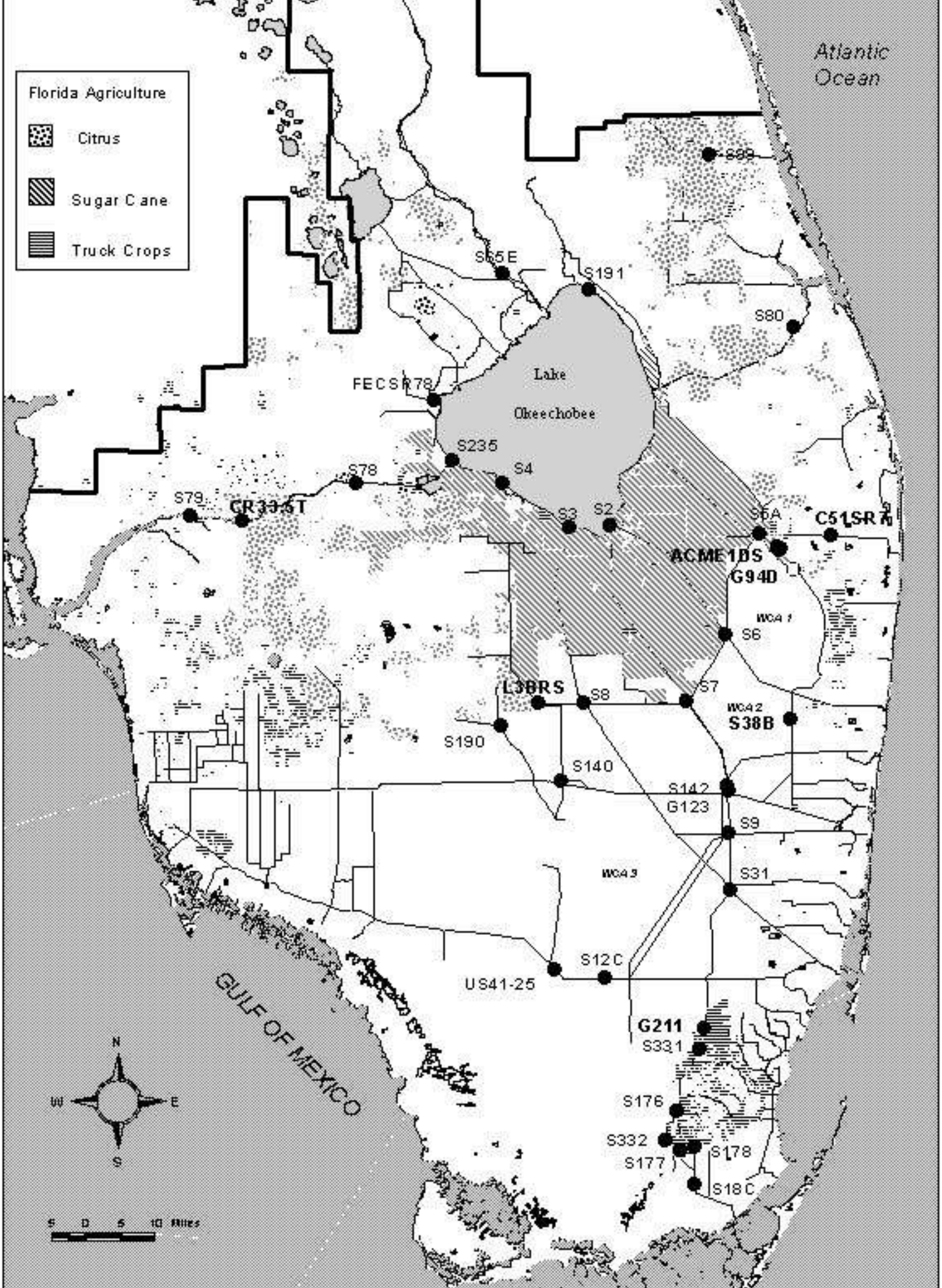
Florida Agriculture
Citrus
Sugar Cane
Truck Crops
Atlantic Ocean
S80
S191
S155E
FECSR78
Lake Okeechobee
S235
S4
S78
S79
CR336T
S3
S2
S6A
C51SR7
ACME1DS
G94D
WCA 1
S6
L38RS
S8
S7
WCA 2
S38B
S190
S140
S142
G123
S9
WCA 3
S31
S12C
US41-25
G211
S331
S176
S332
S178
S177
S18C
GULF OF MEXICO
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W
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S
5 0 5 10 Miles

Table 1. Minimum detection limits (MDL) and practical quantitation limits (PQL) for pesticides determined in January 1999.

Pesticide	Water range of MDL-PQL (µg/L)	Pesticide	Water range of MDL-PQL (µg/L)
2,4-D	2 – 4	endosulfan sulfate	0.0019 - 0.01
2,4,5-T	2 – 4	endrin	0.0019 - 0.19
2,4,5-TP (silvex)	2 – 4	endrin aldehyde	0.0019 - 0.01
alachlor	0.046 - 0.24	ethion	0.019 - 0.1
aldrin	0.00093 - 0.0048	ethoprop	0.019 - 0.1
ametryn	0.0093 - 0.049	fenamiphos (nemacur)	0.028 – 0.15
atrazine	0.0093 - 0.049	fonofos (dyfonate)	0.019 - 0.1
azinphos methyl (guthion)	0.019 – 0.1	heptachlor	0.00093 - 0.095
α-BHC (alpha)	0.00093 - 0.0048	heptachlor epoxide	0.00093 - 0.48
β-BHC (beta)	0.0019 - 0.01	hexazinone	0.019 – 0.1
δ-BHC (delta)	0.00093- 0.0048	imidacloprid	0.4 – 0.8
γ-BHC (gamma) (lindane)	0.00093 - 0.24	linuron	0.4 - 0.8
bromacil	0.037 – 0.19	malathion	0.028 - 0.15
butylate	0.019 - 0.1	metalaxyl	0.056 – 0.29
carbophenothion (trithion)	0.028- 0.029	methoxychlor	0.0037 – 3.8
chlordane	0.0093 – 0.1	metolachlor	0.046 – 0.24
chlorothalonil	0.019 - 0.019	metribuzin	0.019 – 0.1
chlorpyrifos ethyl	0.019 - 0.1	mevinphos	0.037 – 0.19
chlorpyrifos methyl	0.019 - 0.1	mirex	0.0019 - 0.01
cypermethrin	0.0046 - 0.048	naled	0.074 – 0.39
DDD-p,p’	0.0019 - 0.01	norflurazon	0.028 – 0.15
DDE-p,p’	0.0019 - 0.01	parathion ethyl	0.019 – 0.1
DDT-p,p’	0.0019 - 0.01	parathion methyl	0.019 – 0.1
demeton	0.093 – 0.49	PCB	0.019 – 0.1
diazinon	0.019 - 0.1	permethrin	0.046 - 0.019
dicofol (kelthane)	0.019 - 0.038	phorate	0.028 - 0.15
dieldrin	0.0019 - 0.0048	prometryn	0.019 - 0.1
disulfoton	0.028 - 0.15	simazine	0.019 - 0.1
diuron	0.4 - 0.8	toxaphene	0.069 – 0.29
α-endosulfan (alpha)	0.0019 - 0.01	trifluralin	0.0093 - 0.01
β-endosulfan (beta)	0.0019 - 0.01	zinc phosphide	0.5 - 2.0

Table 2. Summary of pesticide residues above the method detection limit found in water samples collected by SFWMD in January 1999

DATE	SITE	FLOW	COMPOUND (µg/L)														Number of compounds detected at site
			ametryn	atrazine	bromacil	diazinon	alpha endosulfan	beta endosulfan	endosulfan sulfate	ethoprop	hexazinone	malathion	metolachlor	metribuzin	norflurazon	simazine	
1/6/99	S38B	no	0.0099 I	1.3	-	0.067 I	-	-	-	-	-	-	-	-	-	-	3
	G123	no	0.016 I	0.087	-	-	-	-	-	-	-	-	-	-	-	-	2
	S142	no	0.016 I	0.043 I	-	-	-	-	-	-	-	-	-	-	-	-	2
	S9	yes	-	0.20	-	-	-	-	-	-	0.020 I	-	-	-	-	-	2
	S31	no	-	0.022 I *	-	-	-	-	-	-	-	-	-	-	-	-	1
	S12C	yes	-	0.029 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	US41-25	yes	-	0.011 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	G211	yes	-	0.012 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	S331	yes	-	0.029 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	S176	no	-	0.029 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	S332	yes	-	0.020 I	-	-	-	-	-	-	-	-	-	-	-	-	1
1/7/99	S177	no	-	0.025 I *	-	-	-	-	-	-	-	-	0.063 I *	-	-	-	2
	S178	no	-	0.067	-	-	0.021	0.016	0.13	-	-	-	-	-	-	-	4
	S18C	no	-	0.026 I	-	-	-	-	-	-	-	-	-	-	-	-	1
	S140	no	-	0.020 I	-	-	-	-	-	-	0.15	-	-	-	-	-	2
	S190	no	-	-	0.083 I	-	-	-	-	-	-	-	0.28	-	0.082 I	-	3
	L3BRS	no	-	0.030 I	-	-	-	-	-	-	-	-	-	-	0.071 I	0.076 I	3
	S8	no	0.013 I	-	-	-	-	-	-	-	-	-	-	-	-	0.029 I	2
1/11/99	G94D	yes	-	0.029 I	-	-	-	-	0.020	-	-	-	-	-	-	-	2
	ACME1DS	yes	0.014 I	0.17		-	-	-	0.018	-	-	-	-	-	-	-	3
	S5A	yes	0.051	0.24	-	-	-	-	-	0.035 I	-	-	0.32	-	-	-	4
	S6	no	0.086	0.71	-	-	-	-	-	-	0.028 I	-	-	-	-	-	3
	S7	no	0.013 I	0.022 I	-	-	-	-	-	-	-	-	-	-	-	-	2
	S2	no	0.052	0.84	-	-	-	-	-	-	-	-	-	-	-	0.020 I	3
	S3	no	0.018 I *	0.20 *	-	-	-	-	-	-	-	-	-	-	-	0.026 I *	3
	S4	no	0.027 I	0.23	-	-	-	-	-	-	-	-	-	-	-	0.022 I	3
	S235	yes	0.044 I	0.22	-	-	-	-	-	-	0.042 I	-	-	-	-	-	3
	S78	yes	0.039 I	0.53	-	-	-	-	-	-	-	-	-	-	-	-	2
	CR33.5T	no	0.013 I	0.51	0.17 I	-	-	-	-	-	-	-	-	-	0.42	0.099	5
	S79	yes	0.011 I	0.36	0.25	-	-	-	-	-	-	-	-	-	0.43	0.10	5
1/12/99	S65E	no	-	-	0.060 I	-	-	-	-	-	-	-	0.066 I	-	-	-	2
	S191	no	-	-	0.071 I *	-	-	-	-	-	0.032 I *	-	-	0.033 I *	-	0.021 I *	4
	S99	no	-	-	0.14 I	-	-	-	-	-	-	0.038 I	-	-	0.70	0.18	4
	S80	no	-	-	-	-	-	-	-	-	-	-	-	-	0.47	0.025 I	2
	C51SR7	no	0.026 I	0.30	-	-	-	-	-	-	-	-	0.14 I	-	0.030 I	-	4
Total number of compound detections			16	29	6	1	1	1	3	1	5	1	5	1	7	10	

- denotes that the result is below the MDL * results are the average of duplicate samples I value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit

Table 3. Selected properties of pesticides found in the January 1999 sampling event.

common name	FDEP Surface Water Standards 62-302 (µg/L)	Florida Ground Water Guidance Conc. (µg/L)	LD_{50} acute rats oral (mg/Kg) (1)	EPA carcinogenic potential	Water Solubility (mg/L) (2, 3)	Koc (ml/g) (2, 3)	soil half-life (days) (2, 3)	SCS rating (2) LE	SA	SS	Bioconcentration Factor (BCF)
ametryn	-	63	1110	D	185	300	60	M	M	M	33
atrazine	-	3**	3080	C	33	100	60	L	M	L	86
bromacil	-	90	5200	C	700	32	60	L	M	M	15
diazinon	-	0.6	240 - 480	E	40	570	40	M	S	L	77
alpha-endosulfan	0.056	0.35	70	-	0.53	12,400	50	XS	L	M	884
beta-endosulfan	-	0.35	70	-	0.28	-	-	-	-	-	1,267
endosulfan sulfate	-	0.3	-	-	0.117	-	-	-	-	-	2,073
ethoprop	-	-	62	-	750	70	25	L	S	M	15
hexazinone	-	231	1690	D	33000	54	90	L	M	M	2
malathion	0.1	140	2,800	D	145	1,800	1	S	S	S	37
metolachlor	-	70	2,780	C	530	200	90	L	M	M	18
metribuzin	-	175	2,200	D	1,220	41	30	L	S	M	11
norflurazon	-	280	9400	-	28	700	90	M	M	L	94
simazine	-	4**	>5000	C	6.2	130	60	L	M	M	221

SCS Ratings are pesticide loss due to leaching (LE), surface adsorption (SA) or surface solution (SS) and grouped as large (L), medium (M), small (S) or extra small (XS)
Bioconcentration Factor (BCF) calculated as BCF = 10^(2.791 - 0.564 log WS) (4)
B2: probable human carcinogen; C: possible human carcinogen; D: not classified; E: evidence of non-carcinogen for humans (5)
FDEP surface water standards (12/96) for Class III water except Class I in ( )
**primary standard

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Table 4. Toxicity of pesticides found in the January 1999 sampling event to selected freshwater aquatic invertebrates and fishes (ug/L).

common name	48 hr EC_{50} Water flea *Daphnia magna*		acute toxicity (*)	chronic toxicity (*)	96 hr LC_{50} Fathead Minnow (#) *Pimephales promelas*		acute toxicity	chronic toxicity	96 hr LC_{50} Bluegill *Lepomis macrochirus*		acute toxicity	chronic toxicity	96 hr LC_{50} Largemouth Bass *Micropterus salmoides*		acute toxicity	chronic toxicity	96 hr LC_{50} Rainbow Trout (#) *Oncorhynchus mykiss*		acute toxicity	chronic toxicity	96 hr LC_{50} Channel Catfish *Ictalurus punctatus*		acute toxicity	chronic toxicity
ametryn	28,000	(7)	9333	1400	-		-	-	4,100	(5)	1367	205	-		-	-	8,800	(5)	2933	440	-		-	-
atrazine	6900	(7)	2300	345	15,000	(7)	5000	750	16,000	(5)	5333	800	-		-	-	8,800	(5)	2933	440	7,600	(5)	2533	380
bromacil	-		-	-	-		-	-	127,000	(7)	42333	6350	-		-	-	36,000	(7)	12000	1800	-		-	-
diazinon	0.8	(1)	0.3	0.04	7,800	(11)	2600	390	168	(1)	56	8.4	-		-	-	90	(1)	30	4.5	-		-	-
	0.9	(4)	0.3	0.045	-		-	-	165	(3)	55	8.3	-		-	-	1,650	(3)	550	83	-		-	-
	-		-	-	-		-	-	16,000	(5)	5333	800	-		-	-	2,900	(5)	967	145	-		-	-
endosulfan	166	(7)	55	8	1	(1)	0.3	0.05	1	(1)	0.33	0.05	-		-	-	1	(1)	0.33	0.050	1	(1)	0.3	0.05
	-		-	-	-		-	-	2	(3)	0.67	0.10	-		-	-	3	(2)	1	0.15	1.5	(7)	0.5	0.08
	-		-	-	-		-	-	-		-	-	-		-	-	1	(3)	0.33	0.050	-		-	-
	-		-	-	-		-	-	-		-	-	-		-	-	0.3	(6)	0.10	0.015	-		-	-
ethoprop	93	(7)	31	4.7	-		-	-	-		-	-	-		-	-	13,800	(5)	4,600	690	-		-	-
hexazinone	151,600	(7)	50533	7580	274,000	(5)	91333	13700	100,000	(7)	33333	5000	-		-	-	180,000	(7)	60000	9000	-		-	-
malathion	1	(1)	0.3	0.05	8,650	(1)	2883	433	103	(1)	34	5.2	285	(1)	95	14	200	(1)	67	10	8,970	(1)	2990	449
	1.8	(4)	0.6	0.09	9,000	(2)	3000	450	110	(2)	37	5.5	-		-	-	170	(2)	57	9	7,620	(7)	2540	381
	-		-	-	-		-	-	12	(10)	4	0.6	-		-	-	100	(10)	33	5	-		-	-
	-		-	-	-		-	-	-		-	-	-		-	-	29	(3)	10	1.5	-		-	-
metolachlor	23,500	(7)	7833	1175	-		-	-	15,000	(5)	5000	750	-		-	-	2,000	(5)	667	100	4,900	(6)	1633	245
metribuzin	4,200	(7)	1,400	210	-		-	-	80,000	(5)	26,667	4,000	-		-	-	64,000	(5)	21,333	3,200	1000,000	(7)	33,333	5,000
norflurazon	15,000	(7)	5000	750	-		-	-	16,300	(7)	5433	815	-		-	-	8,100	(7)	2700	405	>200,000	(5)	>67,000	>10,000
simazine	1,100	(7)	367	55	100,000	(7)	33333	5000	90,000	(5)	30000	4500	-		-	-	100,000	(7)	33333	5000	-		-	-

(*) Florida Administrative Code (FAC) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community.

(#) Species is not indigenous. Information is given for comparison purposes only.

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Figure 2. Ethion Concentration in Surface Water at S99

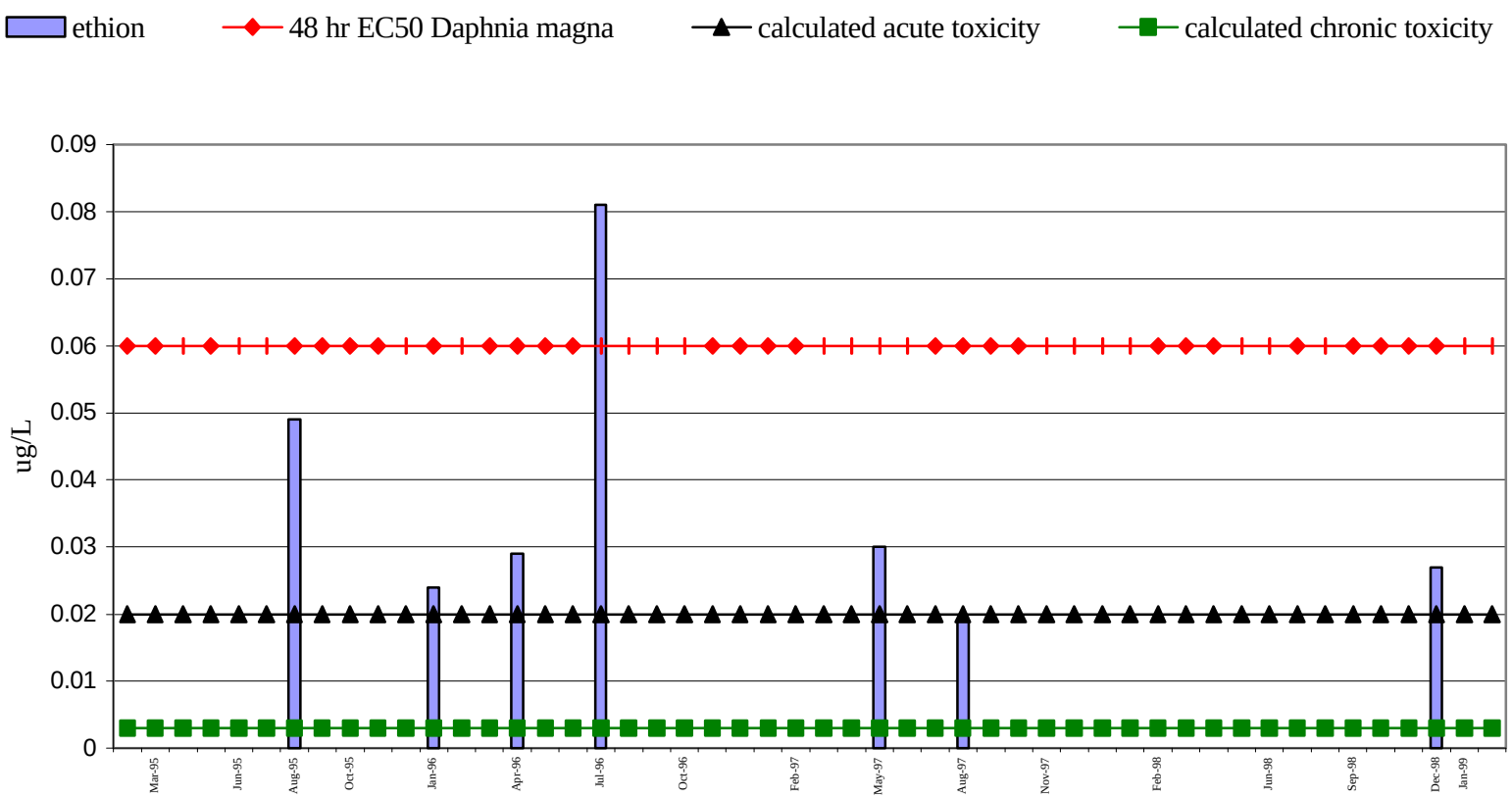

Figure 3. Endosulfan Concentration in Surface Water at S178